University of Bahrain
Department of Computer Science
ITCS314 Automata and Formal Languages

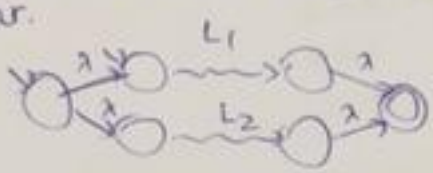
ID:
Name: KEY

Good Morning Practice Quiz 4

Problem 1.

Given two regular languages L_1 and L_2, show that $L_1 \cup L_2$ is always regular.

Since L_1 and L_2 are regular then both can be represented by NFAs, which can then be joined to form $L_1 \cup L_2$ as an NFA. This shows that $L_1 \cup L_2$ is also regular.



Problem 2.

Show that $L=\{a^n : n = 2^s \text{ for some positive integer } s\}$ is not regular.

Let $w = a^{2^m}$ be the word where $w \in L$ and $|w| \geq m$.

w can be decomposed as

$$w = xyz.$$

Since $|xy| \leq m$ and $|y| \geq 1$, then

$$y = a^k \quad \text{for} \quad 1 \leq k \leq m.$$

Thus $w_2 = a^{2^m + k}$

Since $2^m + k > 2^m$ ——— (1)

and $2^m + k \leq 2^m + m$

$< 2^m + 2^m$

$= 2 \cdot 2^m = 2^{m+1}$ ——— (2)

From (1) and (2), $w_2 \notin L$. By the pumping lemma this means that L is not regular.

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Quiz5

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Problem 1.

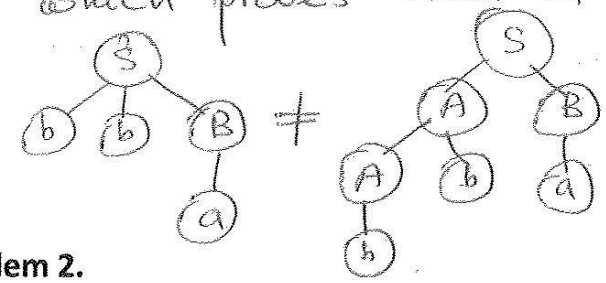
Show that the following grammar is ambiguous.

$S \rightarrow AB \mid bbB$
$A \rightarrow b \mid Ab$
$B \rightarrow a$

accept { Two left-most derivations; Two right-most derivations } for the same word $w \in L$

Two derivation trees ← Easier usually.

Solution:
Let $w = bba$. The following are two derivation trees which proves that G is ambiguous.



Problem 2.

Show that $L=\{ a^n b^m c^k : n + m > k\}$ is context-free.

$S \rightarrow aSc \mid aS \mid aA \mid$ ~~bBA~~ $aA \mid B$

$A \rightarrow bAc \mid bA \mid \lambda$ more a's or both

$B \rightarrow bBc \mid bA \mid b$ more b's

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Quiz 9

ID: KEY
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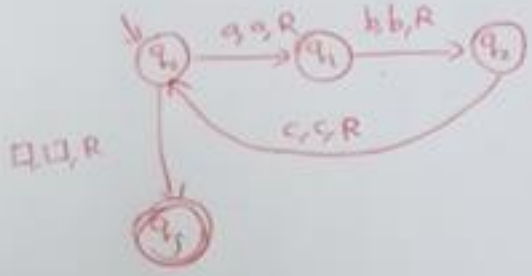
Problem 1.

Construct a Turing Machine for the language $L=\{(abc)^n : n>0\}$.



Problem 2.

Prove that the following function is Turing computable, for all positive integers x. Use unary notation for representing integers on the tape.